

參 考 用

- Two point charges $+Q$ and $-Q$ are situated on a diameter of a grounded conducting sphere of radius a at distances $D > a$ to the right and to the left, respectively.
 - (10%) Find the dipole moment constituted by image charges.
 - (10%) Let D and Q approach infinity in such a way that Q/D^2 remains constant. Superpose the field of $\pm Q$ and of the dipole to find the field outside the sphere.
 - (10%) Assume that the field due to the charges $\pm Q$ is E_0 , find the surface charge density of the sphere.
- (10%) What current density would produce the vector potential, $\vec{A} = k\hat{\phi}$ (k is a constant) in cylindrical coordinates?
- (10%) A thin uniform donut, carrying charge Q and mass M , rotates about its axis. Find the ratio of its magnetic dipole moment to its angular momentum.
- The \mathbf{E} -field of a uniform plane wave propagating in a dielectric medium is given by

$$\mathbf{E}(z, t) = \mathbf{a}_x 2 \cos(10^8 t - \frac{z}{\sqrt{3}}) - \mathbf{a}_y 2 \cos(10^8 t - \frac{z}{\sqrt{3}}) \quad (\text{V/m})$$
 - (3%) What is a uniform plane wave?
 - (7%) What is the dielectric constant of the medium?
 - (5%) Describe the polarization of the wave and explain your answer.
 - (5%) Find the corresponding \mathbf{H} -field.

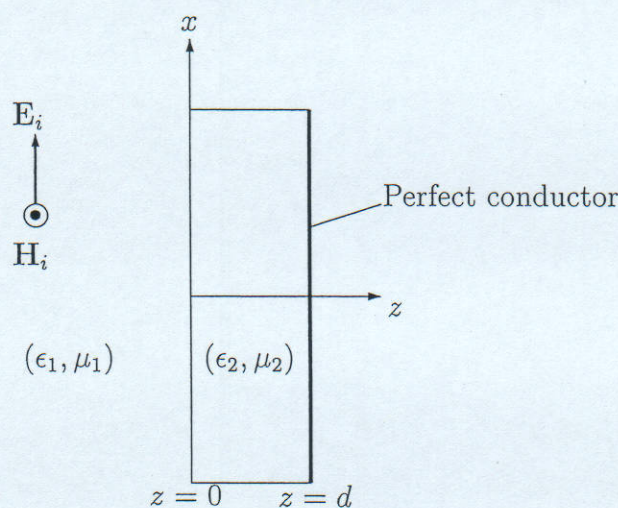
注 意：背面有試題

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5. A time-harmonic uniform plane wave with

$$\mathbf{E}(z) = \mathbf{a}_x E_{i0} e^{-j\beta_1 z}$$

in medium 1 (ϵ_1, μ_1) is incident normally onto a lossless, perfect-conductor-backed dielectric slab (ϵ_2, μ_2) of a thickness d .



- (a) (2%) Please draw the direction of the incident wave vector \mathbf{k}_i .
- (b) (3%) If the amplitude of the reflected electric field in medium 1 is E_{r0} , write down the phasor expressions of the electric ($\mathbf{E}_1(z)$) and magnetic fields ($\mathbf{H}_1(z)$) in medium 1.
- (c) (8%) Assume the propagation constant of the wave in medium 2 is β_2 . Write down the phasor expressions of the electric ($\mathbf{E}_2(z)$) and magnetic fields ($\mathbf{H}_2(z)$) in medium 2 as a function of E_2^+ (the amplitude of the forward-propagating electric field in medium 2), β_2 , d , and (ϵ_2, μ_2) .
- (d) (7%) Applying the boundary condition at $z = 0$ to determine the relationship between E_{i0} and E_{r0} .
- (e) (5%) Find out the thickness d at which $E_{r0} = -E_{i0}$.
- (f) (5%) What is the physical meaning of having $E_{r0} = -E_{i0}$?